SNS • SORCE News Source

Solar Radiation and Climate Experiment Monthly Newsletter **March 2008**

SORCE Team Holds Workshop Prior to 2008 SORCE Meeting –

By Erik Richard, LASP, University of Colorado

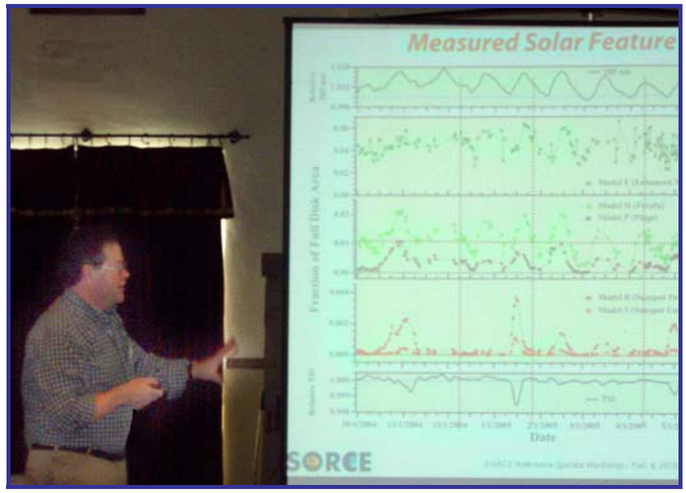
Just prior to the 5th SORCE Science Meeting, Feb. 5-7, the SORCE Science Team hosted a special ½-day workshop to address the development of a solar reference spectrum. The need for a standard and accurate solar spectral irradiance spectrum is of critical importance for a number of applications, such as coupled climate modeling, computational radiative transfer, and validation and calibration activities in remote sensing. As we reach the 5th year of SORCE measurements and the end of solar cycle (SC) 23, we have an unprecedented, continuous record of solar spectral variability over nearly the entire solar spectrum. SORCE has observed moderate and low activity, with several isolated episodes of high activity, i.e. the Halloween Storms of 2003.

The two main objectives in **Towards the Development of a Full Solar Reference Spectrum Workshop,** chaired by Erik Richard (LASP), were to:

1. Establish time periods during the SORCE Mission appropriate for solar cycle minimum and maximum conditions, and to
2. Develop a plan on how to merge different data sets and previous reference spectra for a new SC 24 reference spectra.

Approximately 20 scientists participated in the Solar Reference Spectrum Workshop, Feb. 4, 2008, in Santa Fe, NM, just before the 5th Anniversary SORCE Meeting.

With these goals in mind, the development methodology of a suitable full reference spectrum must include: spectral coverage and resolution, definition of reference time-



Jerry Harder, LASP SORCE Project Scientist, discussed spectral irradiance time series and quantification of solar variability.

frame and associated activity level, and quantification of uncertainties in individual and comparison measurements as well as uncertainties in solar spectral variability. Additionally, the development methodology must be compliant with the incorporation of improvements to existing datasets and the inclusion of future overlapping, continuous measurements.

Over the last several decades, there has been considerable effort dedicated to the development of reference spectra adaptable to a wide range of applications and models (see table, page 2). Building upon previous reference spectra, for example the ATLAS 1 & 3 references for the declining phase of SC 22, we have a unique opportunity to compare similar activity timeframes for two different solar cycles. Daily measurements from SORCE allow for more flexibility in choosing timescales necessary for consideration of a given activity level. For example, rather than relying on a specific, one-time measurement, active feature evolution (or solar rotation) averaging is possible. For inclusion of the SORCE measurements, the time period being considered is between mid-2003 just after solar cycle maximum conditions and the current time near solar minimum. This time period covers half the solar cycle amplitudes in both MgII and F10.7 irradiance proxies.

In an effort to address these issues, the SORCE instrument team held a half-day, open dialog workshop to discuss progress and direction towards a full wavelength coverage solar reference spectrum (0.1 to 2000+ nm) useful to the broader Earth climate communities.

The discussion focused broadly on the methodology for quantifying the conditions for both an active and quiet reference. For example with respect to active conditions, are the conditions for the Oct/Nov 2003 solar storms a representation of solar max? In particular, are active region compositions similar? Image analysis and quantification was viewed as an important component in this discussion since using an indicator like the same level of TSI or any other single quantity/proxy may correspond to significantly different spectral compositions. Several long discussions culminated with the consensus that construction of an active reference when not at solar maximum would be difficult. For spectral irradiance the extrapolation of active time periods during the declining phase would not be a global representation of maximum conditions; for example the active network differences were likely to be very significant.

There was, however, some consensus on how to define a minimum activity reference. In defining a true minimum (low-activity) spectrum, the wavelength dependence of specific activity features could be incorporated to construct a unique "active" spectrum.

Useful discussions focused on all aspects of minimum indicators (and timeframes) including low TSI, lack of visible sunspots, faculae and plage, broadly distributed network and magnetic activity, and low proxy indicators. Again, image analysis was viewed as an important component in the quantification.

The meeting adjourned with action items for the various data groups to identify dates that meet minimum activity criteria. Immediately following the workshop, the SORCE Science Meeting kicked-off with a Welcoming Reception.

Some Previous Solar Reference Spectra

Reference	Data Source	Wavelength Range	Wavelength Bins	Accuracy
WRC1985 - single spectrum Wehrli, *PMO/WRC-165*, 1985.	B&S, 1981 Arvesen, 1969 N&L, 1984 S&G, 1974	200-310 nm 310-330 nm 330-869 nm 0.869-10 µm	1 nm bins 0.4 nm bins 1-2 nm bins 2-1000 nm	
ASTM E-490 - single spectrum ASTM, 2000.	UARS N&L 1984 Kurucz 1993 S&G 1974	119-410 nm 410-825 nm 825-4000 nm 4-20 µm	1 nm bins 1-2 nm bins 2-20 nm bins 20-1000 nm	3-10%
VUV2002 - solar cycle, rotation Woods & Rottman, *GMS-130*, 2002.	AE-E, Rocket UARS	0.1-115 nm 115-420 nm	1 nm bins 1 nm bins	30-50% 3-10%
ATLAS - solar cycle Thuillier *et al.*, *GMS-141*, 2004.	VUV2002 UARS/ATLAS SOLSPEC SOSP	0.1-120 nm 120-400 nm 400-870 nm 860-2400 nm	1 nm bins 0.05 nm bins ~0.03 nm ~0.2 nm	30-50% 3-10% 3-5% 3-5%

CAWSES Sponsors International Workshop –

SORCE team members will be participating in the upcoming workshop, **Solar Variability, Earth's Climate and the Space Environment,** in Bozeman, Montana, June 1-6, 2008. This workshop is sponsored by CAWSES, Goddard Earth Sciences and Technology Center, IHY, Montana State University, and the NASA-LWS Program.

This international workshop will bring together solar and space physicists, climatologists and other interested scientists to discuss the physics of solar variability and the pathways through which the latter influences our space environment and the global climate. Understanding the causes and consequences of global climate change and protecting our rapidly developing technologies in space and on Earth are becoming increasingly important. This workshop will address these diverse but connected sciences, enabling a cross-disciplinary dialogue and exchange of ideas that is expected to positively impact our overall understanding of the Sun-Earth system.

SORCE PI Tom Woods will be giving an invited talk on *"The Total Solar Irradiance Record"* in Session 2, Solar Radiative Output Variations and Modeling.

The pre-registration deadline is coming up quickly - April 11. For program, abstract submission, and registration information, visit their website: http://solar.physics.montana.edu/SVECSE2008/.

New LASP Solar Team Member –

Margit Haberreiter, most recently from PMOD (Physikalisch-Metorologisches Observatorium Davos) in Switzerland, joined the LASP Solar Influences team in February as a Postdoctoral Research Associate. Until the end of 2007, Margit had been working at the PMOD/World Radiation Center as a postdoctoral researcher in the fields of solar atmosphere seismology and solar UV irradiance modeling. She is a Co-Investigator on the SODISM instrument for the PICARD Mission.

Margit Haberreiter began her advanced education at the University of Tübingen in Germany, and completed her PhD at PMOD/WRC.

At LASP, Margit is collaborating with Juan Fontenla in developing physics-based models of solar irradiance variations in the UV range, and creating operational tools for forecasting these irradiance variations. Their work involves spectral observations and modeling the solar electromagnetic radiation spectrum at all wavelengths with emphasis on the EUV. This effort is needed to define the relationship between solar physical processes and the spectral and total irradiance, and allows the SORCE observations to be framed into the broader context of past and future solar variations. The SORCE data is an essential tool for validating and further developing the physical models. Margit's knowledge and experience will be most helpful in this endeavor, and we welcome her!

2008 SORCE Meeting Summary –

The February 2008 SORCE Science Meeting, **SORCE's Past, Present, and Future Role in Earth Science Research,** in Santa Fe, NM, was a huge success thanks to the contributions from our excellent presenters and meeting participants. A complete meeting summary, the oral and poster presentations, and a photo gallery are available on the SORCE Meeting website.

http://lasp.colorado.edu/sorce/2008SciMeeting

In spite of cold temperatures in Santa Fe, NM, most of the 2008 SORCE Science Meeting attendees met for an outdoor group photo.

421,508

Hits to the SORCE Website

(Since 4/21/03, As of 3/21/08)

Fontenla Paper Published in Astronomy & Astrophysics –

"Chromospheric Heating by the Farley-Buneman Instability", by Juan Fontenla, Bill Peterson, and Jerry Harder is available in *Astronomy & Astrophysics*. The exact reference is: Fontenla, J. M., W. K. Peterson, and J. Harder, *A&A,* **480,** 3, 39-846, 2008. Below is a brief summary/abstract of that paper.

Context. Chromospheric heating produces UV emissions that can only occur in an enhanced electron temperature medium. In the quiet-Sun the radiative losses are orders of magnitude larger than those in the much hotter corona. Chromospheric heating mechanisms previously considered (e.g. shock waves and nanoflares) have failed to account for the observed persistency and uniformity of UV lines and continua. Also resistive magnetic free-energy dissipation is not efficient enough in the highly electrically conductive solar atmosphere.

Aims. In this paper we consider plasma effects in the low-chromosphere and propose that the Farley-Buneman (hereafter FB) plasma instability mechanism provides the mechanism for dissipating the energy of convectively driven motions of neutral atoms into chromospheric heating in the Sun and other cool stars that have a partially ionized chromosphere.

Methods. Analysis of the ion acoustic sound speed and consideration of recent measurements of magnetic field in the quiet, inter-network, solar low-chromosphere are carried in the context of understanding the characteristics and onset of chromospheric heating. The FB instability is triggered by the cross-field motion of the partially ionized gas at velocities in excess of the ion acoustic velocity. The ions acquire their cross field velocities through collisions with the much more dense chromospheric neutral atoms. Estimates of cross-field velocities are obtained from consideration of both, spectral line widths and convection numerical simulations that indicate values from a few to several km s^{-1} at the top of the practically radiative-equilibrium low chromosphere.

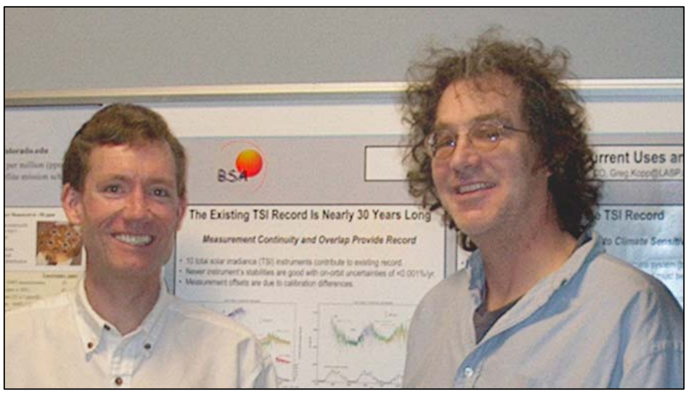
Results. The FB instability is triggered by the cross-field motion of the neutral component of the partially ionized gas at velocities in excess of the ion acoustic velocity. This instability occurs in the solar chromosphere because electrons become strongly magnetized just above the photosphere while heavy ions and protons remain unmagnetized and only at the very top of the chromosphere do they become magnetized.

Conclusions. We find that convective overshoot motions are likely the main drivers of the FB instability and provide sufficient energy to account for the upper chromospheric radiative losses in the quiet-Sun internetwork and network lanes.

SORCE Represented at Boulder Solar Days –

The LASP SORCE team participated in the annual Boulder Solar Days held March 17-18, at NCAR. The purpose of this gathering is for local solar scientists to learn what their fellow researchers are up to. This year the program highlighted scientific observations at ground-based facilities such as those of the National Solar Observatory, in addition to the science from the Boulder solar community (NCAR/HAO, NOAA, LASP, NWRA/CoRA, SwRI).

LASP's Mark Rast gave a technical talk on the "Latitudinal Variation in the Solar Intensity", where he discussed his work with Precision Solar Photometric Telescope (PSPT) images taken at the Mauna Loa Solar Observatory in Hawaii. SORCE scientists had 2 posters presented at the 1.5 day meeting — *A Tale of Two SOLSTICEs* by Marty Snow, and *Total Solar Irradiance – Current Uses and Future Plans* by Greg Kopp. Greg Kopp, an organizing committee member, ended the conference with a closing summary.



TIM instrument scientist Greg Kopp (left) and Mark Rast (right) participated in Boulder Solar Days, March 17-18.

Upcoming Meetings / Talks –

SORCE scientists plan to present papers or attend the following 2008 meetings:

AGU Spring Meeting, May 27-30, Ft. Lauderdale, FL

CAWSES (SCOSTEP), June 1-6, Bozeman, MT

37th COSPAR Scientific Assembly, July 13-20, Montreal, Canada

International Radiation Symposium (IRS2008), Aug. 3-8, Iguacu Falls, Brazil

To submit information to this newsletter, please contact: vanessa.george@ lasp.colorado.edu.